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Muon Array with RPCs for Tagging Air showers (MARTA)

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We discuss the concept of an array with Resistive Plate Chambers (RPC) for muon detection in ultra-high energy cosmic ray (UHECR) experiments. RPC have been used in particle physics experiments due to their fast timing properties and spatial resolution. The operation of a ground array detector poses challenging demands, as the RPC must operate remotely under extreme environment, with limited power and minimal maintenance. In its baseline configuration, each MARTA unit includes one 1.5x1.2 mˆ2 RPC, with 64 pickup electrodes (pads). The DAQ system is based on a ASIC, allowing to readout the high number of channels with low power consumption. Data is recorded using a dual technique: single particle counting with a simple threshold on the signal from each pad and charge integration for high occupancy. The RPC, DAQ, High Voltage and monitoring systems are enclosed in an aluminum-sealed case, providing a compact and robust unit suited for outdoor environments, which can be easily deployed and connected. The RPCs developed at LIP-Coimbra are able to operate using very low gas flux, which allows running them for few years with a small gas reservoir. Several full-scale units are already installed and taking data in several locations and with different configurations, proving the viability of the MARTA concept.
By shielding the detector units with enough slant mass to absorb the electromagnetic component in the air showers, a clean measurement of the muon content is allowed, a concept to be implemented in a next generation of UHECR experiments. The specificities of a MARTA unit are presented, which include particle counting with high efficiency, time resolution and spatial segmentation. The potential of the MARTA concept for muon measurements in air showers is assessed, as well as tentative methods for calibration and cross-calibrations with existing detectors.

Collaboration

– not specified –

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589

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